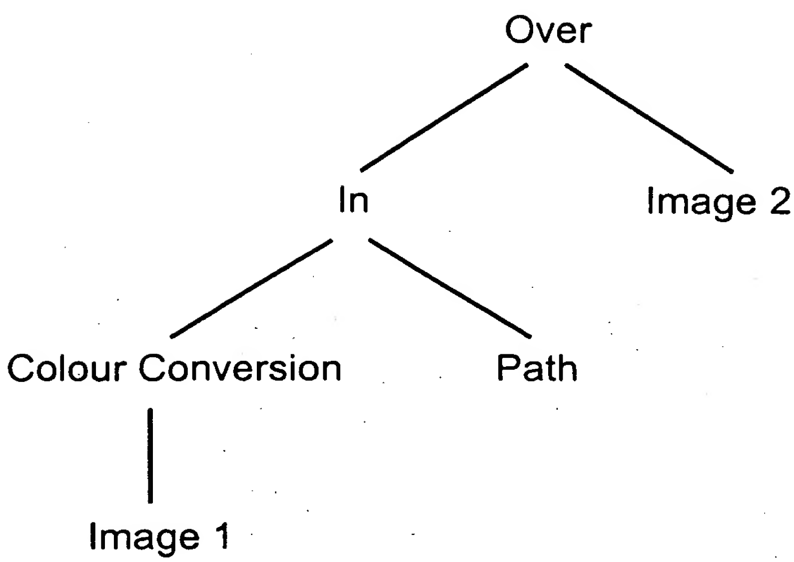


Fig. 1

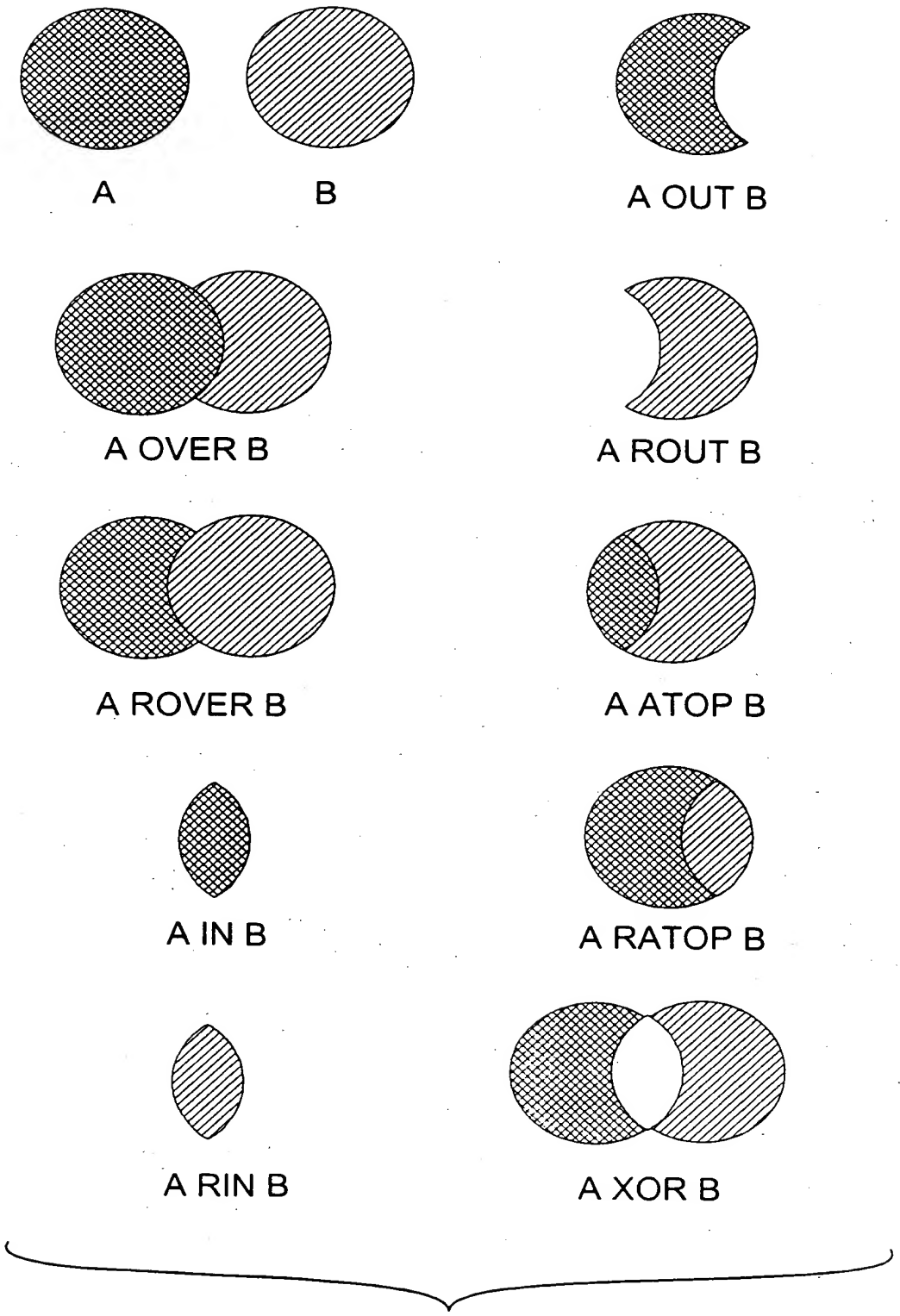
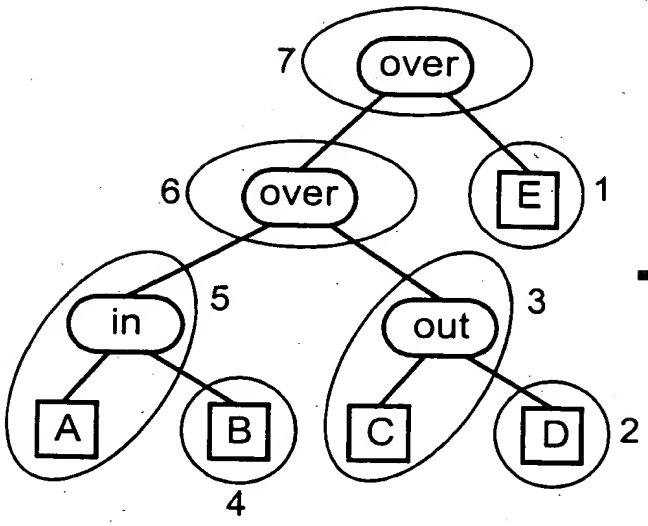

A
B
A OUT B
A OVER B
A ROUT B
A ROVER B
A ATOP B
A IN B
A RATOP B
A RIN B
A XOR B

Fig. 2



operation	fill
over	pop
over	pop
in	A
push	B
out	C
push	D
push	E

Fig. 3

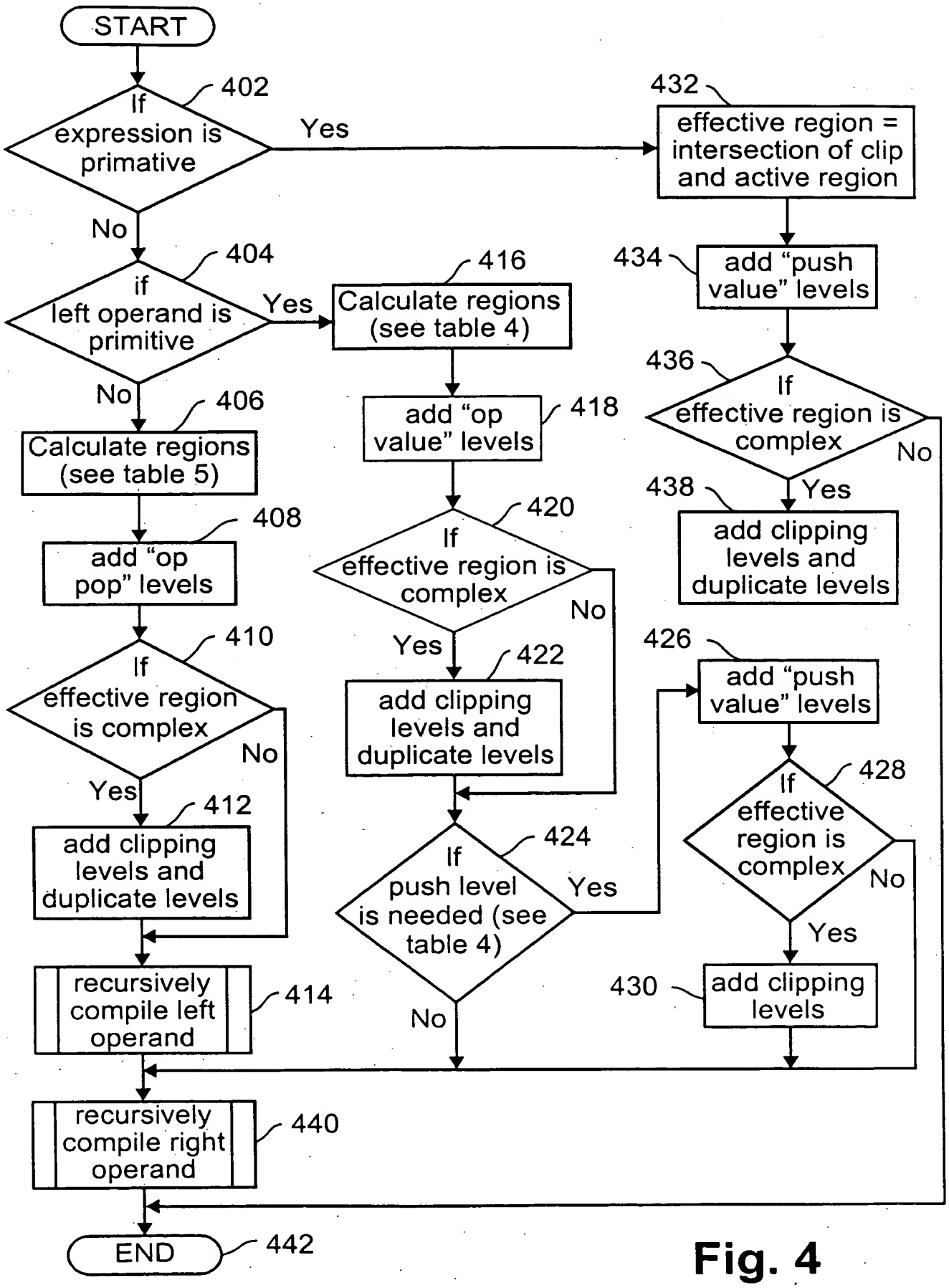

START
402
If expression is primative
Yes
No
404
if left operand is primitive
Yes
No
406
Calculate regions (see table 5)
408
add "op pop" levels
410
If effective region is complex
Yes
No
412
add clipping levels and duplicate levels
414
recursively compile left operand
416
Calculate regions (see table 4)
418
add "op value" levels
420
If effective region is complex
Yes
No
422
add clipping levels and duplicate levels
424
If push level is needed (see table 4)
Yes
No
426
add "push value" levels
428
If effective region is complex
Yes
No
430
add clipping levels
432
effective region = intersection of clip and active region
434
add "push value" levels
436
If effective region is complex
Yes
No
438
add clipping levels and duplicate levels
440
recursively compile right operand
END
442

Fig. 4

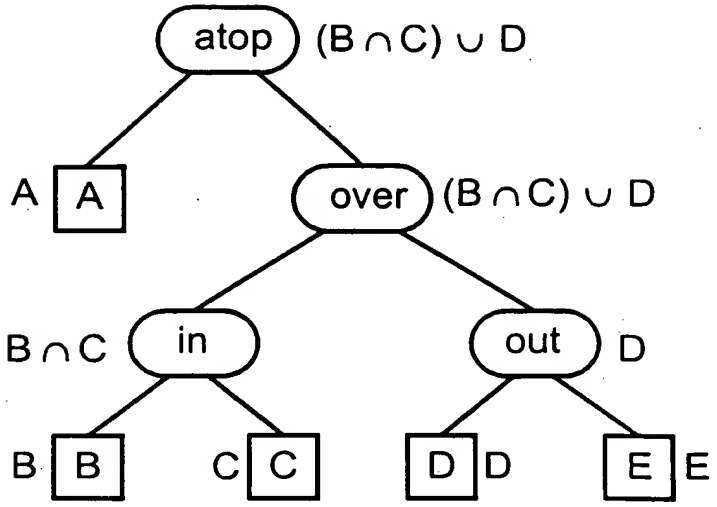

atop
(B ∩ C) ∪ D
A
A
over
(B ∩ C) ∪ D
B ∩ C
in
out
D
B
B
C
C
D
D
E
E

Fig. 5

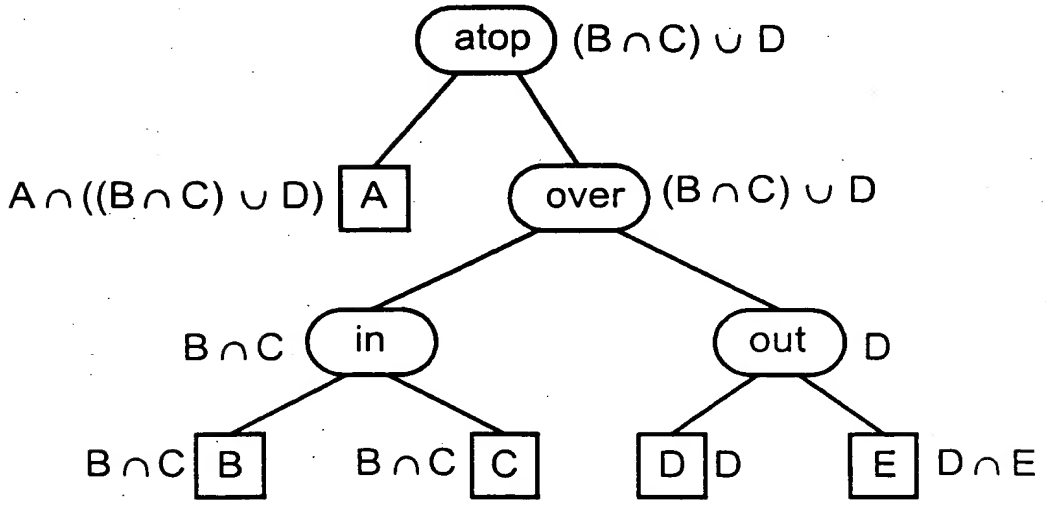

atop
(B ∩ C) ∪ D
A ∩ ((B ∩ C) ∪ D)
A
over
(B ∩ C) ∪ D
B ∩ C
in
out
D
B ∩ C
B
B ∩ C
C
D
D
E
D ∩ E

Fig. 6

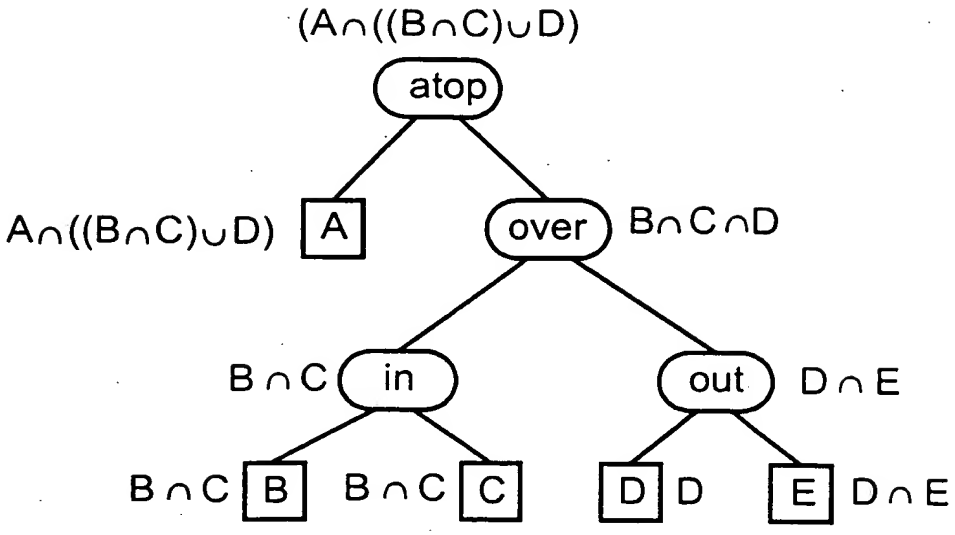
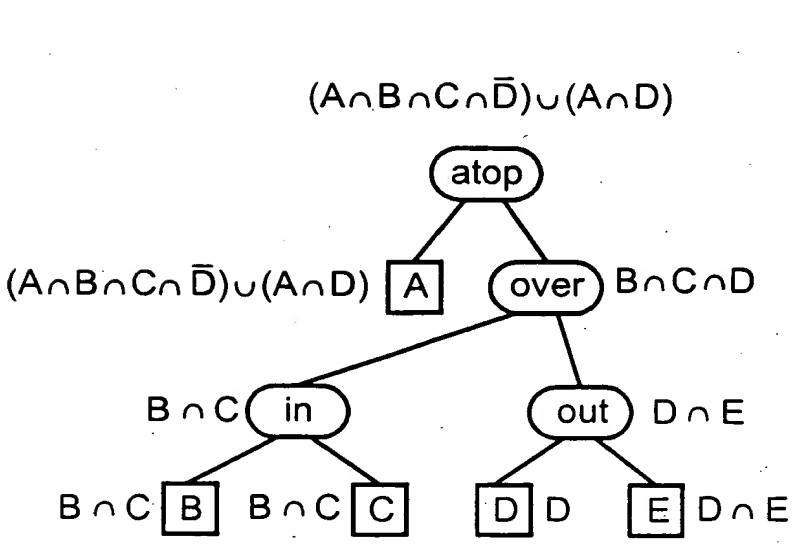


Fig. 7



operation	fill
atop	A
atop	A
over	pop
in	B
push	C
out	D
push	D
push	E
clip	E
clip	$\bar{E}$
clip	C
clip	B
clip	D
clip	$\bar{D}$

Fig. 8

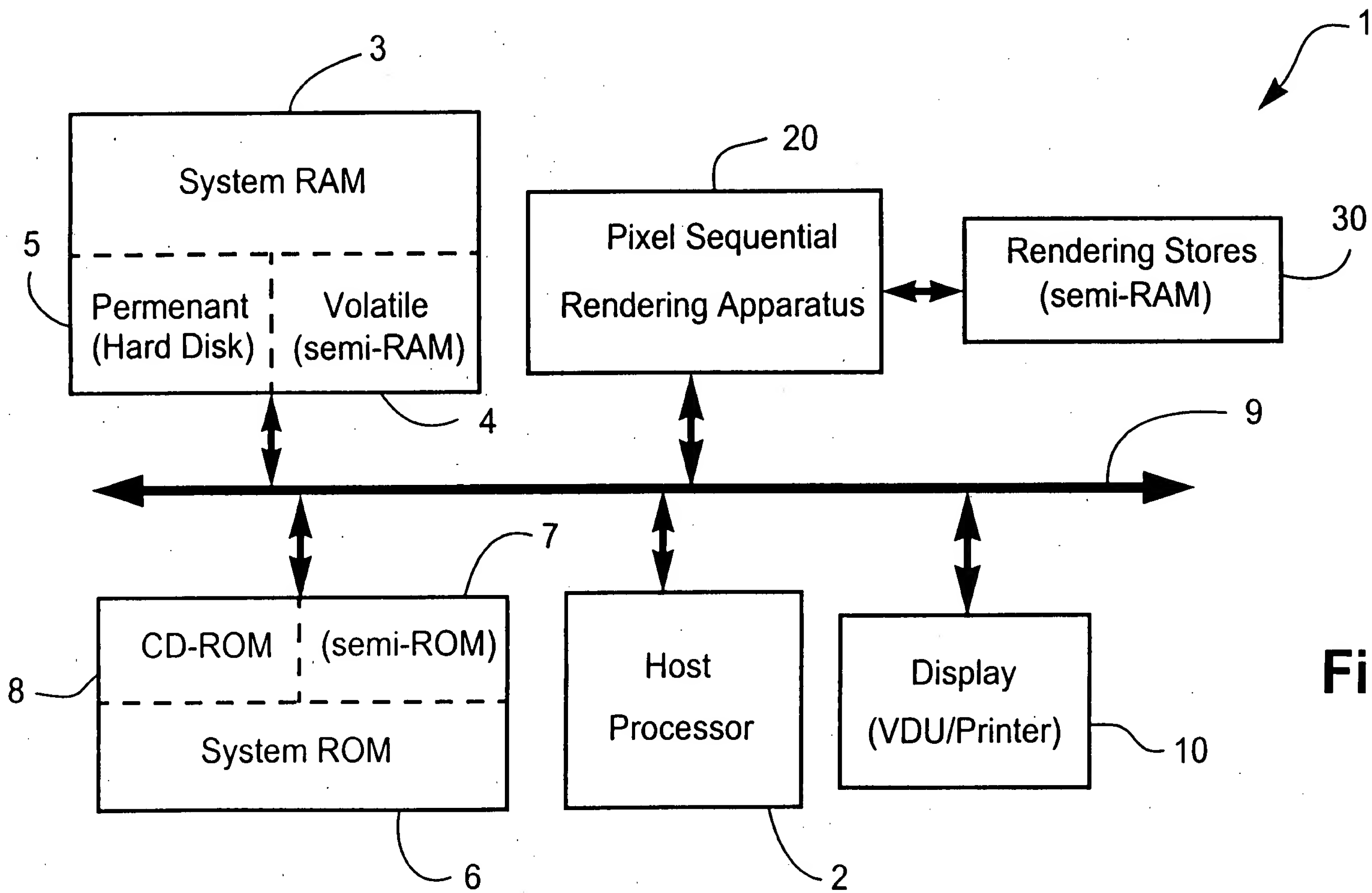

1
3
System RAM
5
Permenant
(Hard Disk)
Volatile
(semi-RAM)
4
20
Pixel Sequential
Rendering Apparatus
30
Rendering Stores
(semi-RAM)
9
7
8
CD-ROM
(semi-ROM)
System ROM
6
Host
Processor
2
Display
(VDU/Printer)
10

Fig. 9

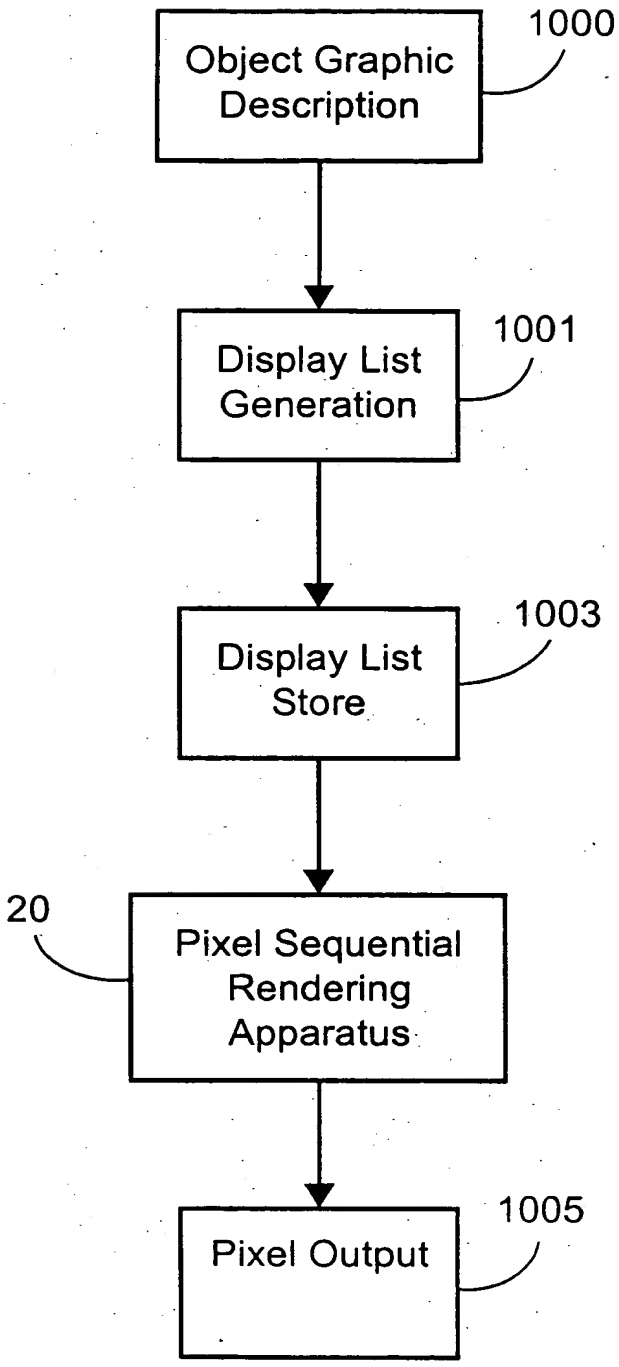

Object Graphic Description
1000
Display List Generation
1001
Display List Store
1003
20
Pixel Sequential Rendering Apparatus
Pixel Output
1005

FIG. 10

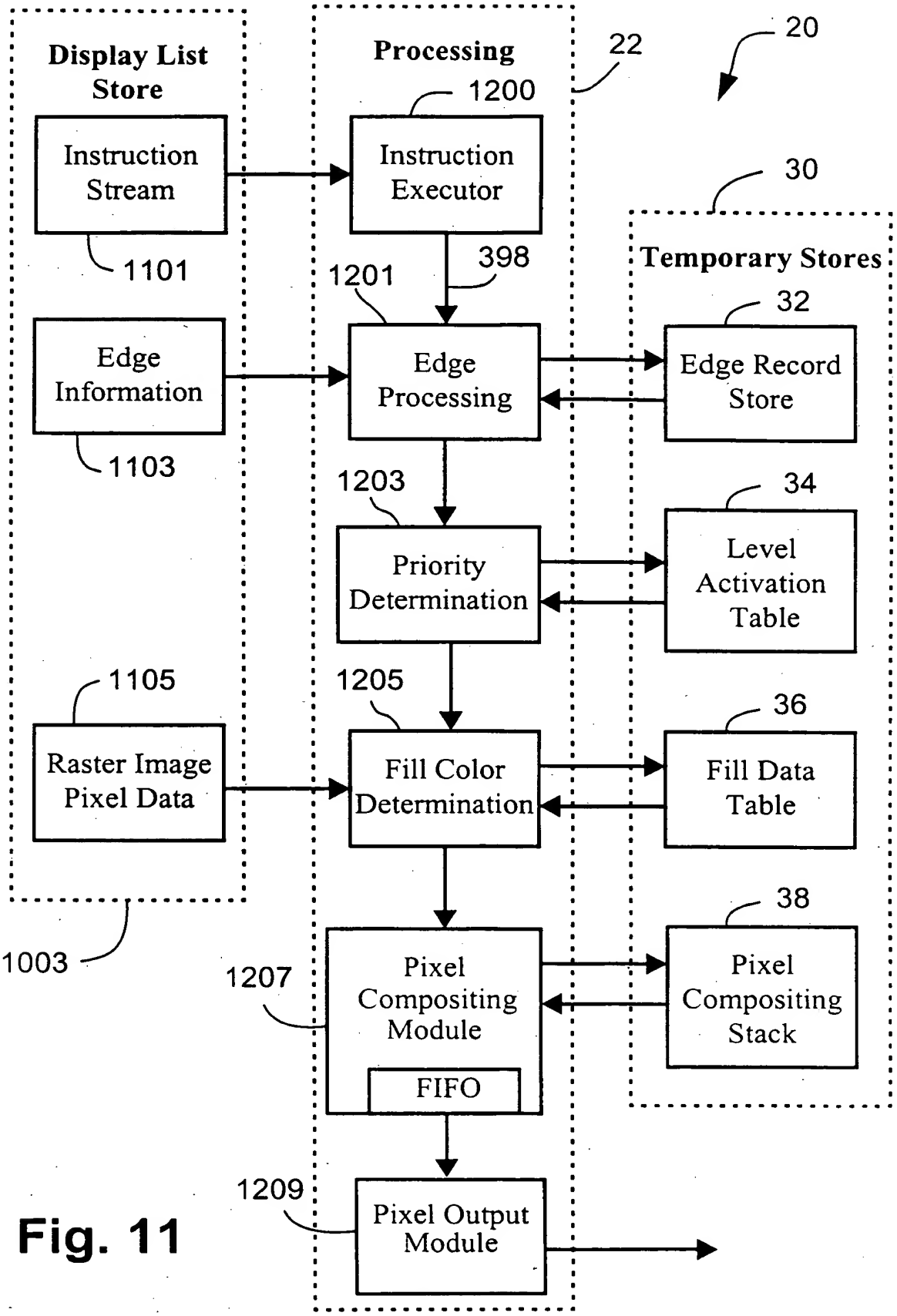

Display List Store
Instruction Stream
1101
Edge Information
1103
1105
Raster Image Pixel Data
1003
Processing
22
20
1200
Instruction Executor
398
1201
Edge Processing
1203
Priority Determination
1205
Fill Color Determination
1207
Pixel Compositing Module
FIFO
1209
Pixel Output Module
30
Temporary Stores
32
Edge Record Store
34
Level Activation Table
36
Fill Data Table
38
Pixel Compositing Stack

Fig. 11

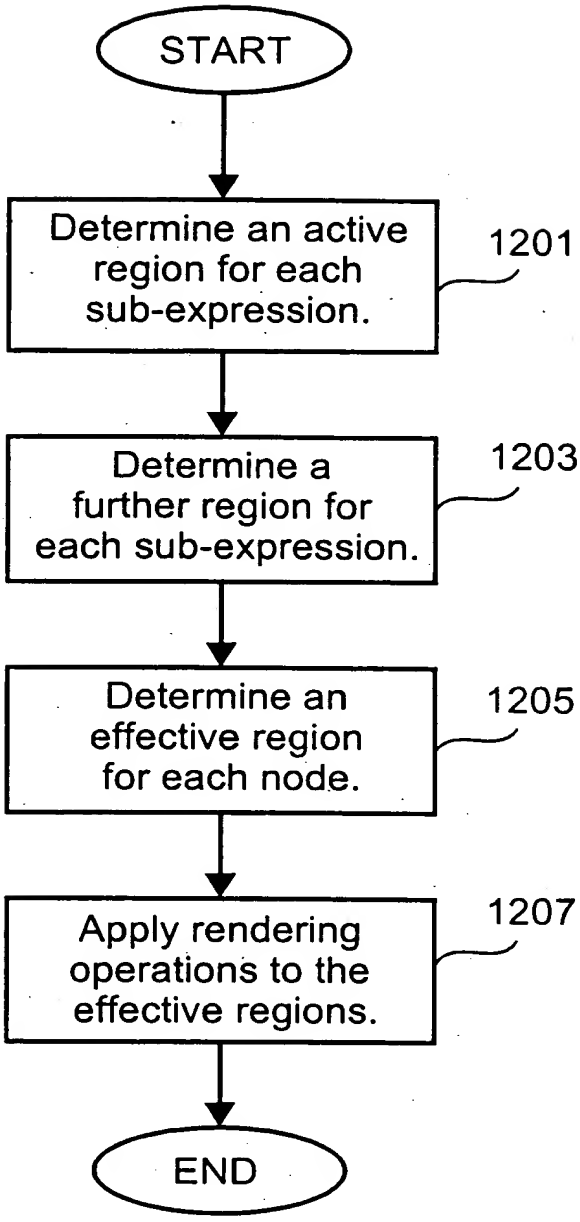

START
Determine an active region for each sub-expression.
1201
Determine a further region for each sub-expression.
1203
Determine an effective region for each node.
1205
Apply rendering operations to the effective regions.
1207
END

Fig. 12

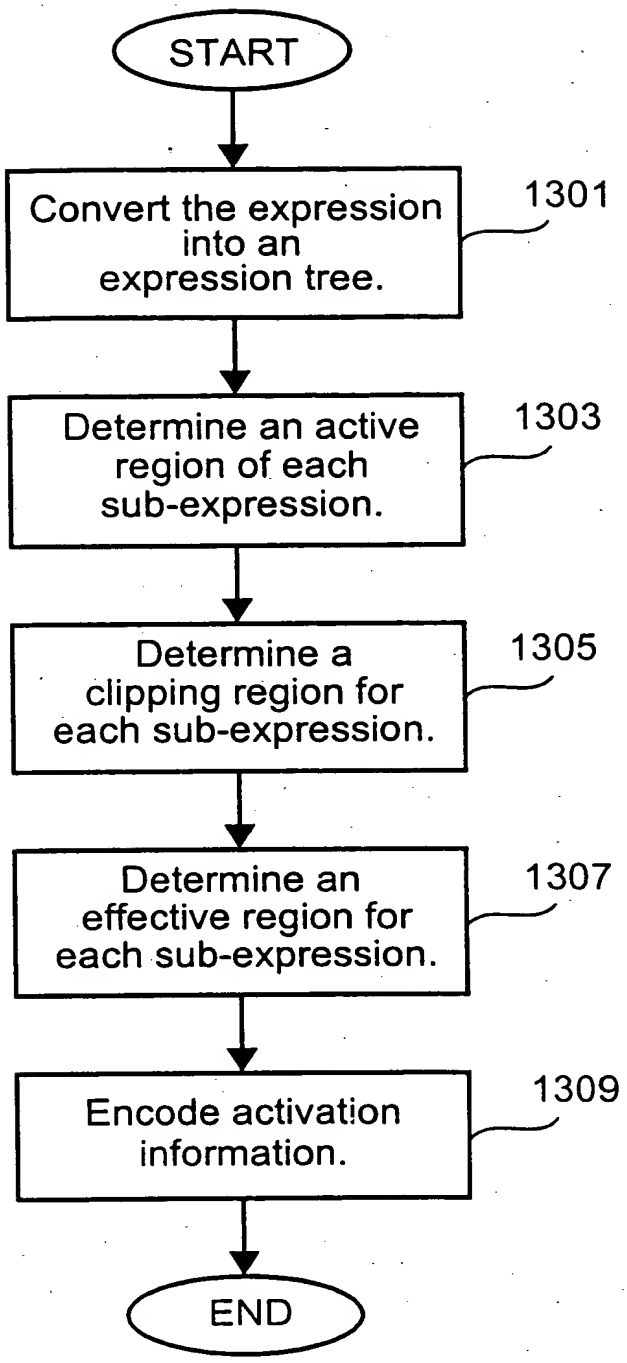

START
Convert the expression into an expression tree.
1301
Determine an active region of each sub-expression.
1303
Determine a clipping region for each sub-expression.
1305
Determine an effective region for each sub-expression.
1307
Encode activation information.
1309
END

Fig. 13

Operation	Region	Value	Level	Stack	Result	Correct
A over B	$A \cap B$	A over B	over A	B	A over B	A over pop
	$A \cap \bar{B}$	A		?	A over ?	push A
	$\bar{A} \cap B$	B		B	B	no-op
	$\bar{A} \cap \bar{B}$	glass		?	?	no-op
A rover B	$A \cap B$	A rover B	rover A	B	A rover B	A rover pop
	$A \cap \bar{B}$	A		?	A rover ?	push A
	$\bar{A} \cap B$	B		B	B	no-op
	$\bar{A} \cap \bar{B}$	glass		?	?	no-op
A in B	$A \cap B$	A in B	in A	B	A in B	A in pop
	$A \cap \bar{B}$	glass		?	A in ?	no-op
	$\bar{A} \cap B$	glass		B	B	pop
	$\bar{A} \cap \bar{B}$	glass		?	?	no-op
A rin B	$A \cap B$	A rin B	rin A	B	A rin B	A rin pop
	$A \cap \bar{B}$	glass		?	A rin ?	no-op
	$\bar{A} \cap B$	glass		B	B	pop
	$\bar{A} \cap \bar{B}$	glass		?	?	no-op
A out B	$A \cap B$	A out B	out A	B	A out B	A out pop
	$A \cap \bar{B}$	A		?	A out ?	push A
	$\bar{A} \cap B$	glass		B	B	pop
	$\bar{A} \cap \bar{B}$	glass		?	?	no-op
A rout B	$A \cap B$	A rout B	rout A	B	A rout B	A rout pop
	$A \cap \bar{B}$	glass		?	A rout ?	no-op
	$\bar{A} \cap B$	B		B	B	no-op
	$\bar{A} \cap \bar{B}$	glass		?	?	no-op
A atop B	$A \cap B$	A atop B	atop A	B	A atop B	A atop pop
	$A \cap \bar{B}$	glass		?	A atop ?	no-op
	$\bar{A} \cap B$	B		B	B	no-op
	$\bar{A} \cap \bar{B}$	glass		?	?	no-op
A ratop B	$A \cap B$	A ratop B	ratop A	B	A ratop B	A ratop pop
	$A \cap \bar{B}$	A		?	A ratop ?	push A
	$\bar{A} \cap B$	glass		B	B	pop
	$\bar{A} \cap \bar{B}$	glass		?	?	no-op
A xor B	$A \cap B$	A xor B	xor A	B	A xor B	A xor pop
	$A \cap \bar{B}$	A		?	A xor ?	push A
	$\bar{A} \cap B$	B		B	B	no-op
	$\bar{A} \cap \bar{B}$	glass		?	?	no-op

Table 1

Operation	Region	Value	Level	Stack	Result	Correct
A over B	$A \cap B$	A over B	over	A,B	A over B	over
	$A \cap \bar{B}$	A		A,?	A over ?	no-op
	$\bar{A} \cap B$	B		B,?	B over ?	no-op
	$\bar{A} \cap \bar{B}$	glass		?,?	? over ?	no-op
A rover B	$A \cap B$	A rover B	rover	A,B	A rover B	rover
	$A \cap \bar{B}$	A		A,?	A rover ?	no-op
	$\bar{A} \cap B$	B		B,?	B rover ?	no-op
	$\bar{A} \cap \bar{B}$	glass		?,?	? rover ?	no-op
A in B	$A \cap B$	A in B	in	A,B	A in B	in
	$A \cap \bar{B}$	glass		A,?	A in ?	pop
	$\bar{A} \cap B$	glass		B,?	B in ?	pop
	$\bar{A} \cap \bar{B}$	glass		?,?	? in ?	no-op
A rin B	$A \cap B$	A rin B	rin	A,B	A rin B	rin
	$A \cap \bar{B}$	glass		A,?	A rin ?	pop
	$\bar{A} \cap B$	glass		B,?	B rin ?	pop
	$\bar{A} \cap \bar{B}$	glass		?,?	? rin ?	no-op
A out B	$A \cap B$	A out B	out	A,B	A out B	out
	$A \cap \bar{B}$	A		A,?	A out ?	no-op
	$\bar{A} \cap B$	glass		B,?	B out ?	pop
	$\bar{A} \cap \bar{B}$	glass		?,?	? out ?	no-op
A rout B	$A \cap B$	A rout B	rout	A,B	A rout B	rout
	$A \cap \bar{B}$	glass		A,?	A rout ?	pop
	$\bar{A} \cap B$	B		B,?	B rout ?	no-op
	$\bar{A} \cap \bar{B}$	glass		?,?	? rout ?	no-op
A atop B	$A \cap B$	A atop B	atop	A,B	A atop B	atop
	$A \cap \bar{B}$	glass		A,?	A atop ?	pop
	$\bar{A} \cap B$	B		B,?	B atop ?	no-op
	$\bar{A} \cap \bar{B}$	glass		?,?	? atop ?	no-op
A ratop B	$A \cap B$	A ratop B	ratop	A,B	A ratop B	ratop
	$A \cap \bar{B}$	A		A,?	A ratop ?	no-op
	$\bar{A} \cap B$	glass		B,?	B ratop ?	pop
	$\bar{A} \cap \bar{B}$	glass		?,?	? ratop ?	no-op
A xor B	$A \cap B$	A xor B	xor	A,B	A xor B	xor
	$A \cap \bar{B}$	A		A,?	A xor ?	no-op
	$\bar{A} \cap B$	B		B,?	B xor ?	no-op
	$\bar{A} \cap \bar{B}$	glass		?,?	? xor ?	no-op

Table 2

Expression	Active Region
A over B	$A \cup B$
A rover B	$A \cup B$
A in B	$A \cap B$
A rin B	$A \cap B$
A out B	A
A rout B	B
A atop B	B
A ratop B	A
A xor B	$A \cup B$

Table 3

Operation	Levels	Clip
A over B	over A	clip ∩ B
	push A	clip ∩ $\overline{B}$
	table B	clip
A rover B	rover A	clip ∩ B
	push A	clip ∩ $\overline{B}$
	table B	clip
A in B	in A	clip ∩ B
	table B	clip ∩ A
A rin B	rin A	clip ∩ B
	table B	clip ∩ A
A out B	out A	clip ∩ B
	push A	clip ∩ $\overline{B}$
	table B	clip ∩ A
A rout B	rout A	clip ∩ B
	table B	clip
A atop B	atop A	clip ∩ B
	table B	clip
A ratop B	ratop A	clip ∩ B
	push A	clip ∩ $\overline{B}$
	table B	clip ∩ A
A xor B	xor A	clip ∩ B
	push A	clip ∩ $\overline{B}$
	table B	clip

Table 4

Operation	Levels	Clip
A over B	over	clip ∩ A ∩ B
	table A	clip
	table B	clip
A rover B	rover	clip ∩ A ∩ B
	table A	clip
	table B	clip
A in B	in	clip ∩ A ∩ B
	table A	clip ∩ B
	table B	clip ∩ A
A rin B	rin	clip ∩ A ∩ B
	table A	clip ∩ B
	table B	clip ∩ A
A out B	out	clip ∩ A ∩ B
	table A	clip
	table B	clip ∩ A
A rout B	rout	clip ∩ A ∩ B
	table A	clip ∩ B
	table B	clip
A atop B	atop	clip ∩ A ∩ B
	table A	clip ∩ B
	table B	clip
A ratop B	ratop	clip ∩ A ∩ B
	table A	clip
	table B	clip ∩ A
A xor B	xor	clip ∩ A ∩ B
	table A	clip
	table B	clip

Table 5

Expression	Clip A	Clip B	Active Region	Opaque Region
A over B	A	$B \cap \bar{O}_A$	$A \cup B$	$O_A \cup O_B$
A rover B	$A \cap \bar{O}_B$	B	$A \cup B$	$O_A \cup O_B$
A in B	$A \cap B$	$A \cap B \cap \bar{O}_B$	$A \cap B$	$O_A \cap O_B$
A rin B	$A \cap B \cap \bar{O}_A$	$A \cap B$	$A \cap B$	$O_A \cap O_B$
A out B	$A \cap B \cap \bar{O}_B$	$A \cap B$	$A \cap \bar{O}_B$	$\bar{B} \cap O_A$
A rout B	$A \cap B$	$A \cap B \cap \bar{O}_A$	$B \cap \bar{O}_A$	$\bar{A} \cap O_B$
A atop B	$A \cap B$	$A \cap B \cap \bar{O}_A$	B	O_B
A ratop B	$A \cap B \cap \bar{O}_B$	$A \cap B$	A	O_A
A xor B	$A \cap (\bar{O}_B \cup \bar{O}_A)$	$B \cap (\bar{O}_B \cup \bar{O}_A)$	$(A \cup B) \cap (\bar{O}_A \cup \bar{O}_B)$	$(\bar{B} \cap O_A) \cup (\bar{A} \cap O_B)$

Table 6